

1 WE CLAIM:

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3 1. A gas centrifuge means operating to
4 separate gases of differing chemical composition and
5 molecular weight by a centrifugal force field.

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8 2. A gas centrifuge means operating to
9 separate carbon dioxide from methane by a centrifugal
10 force field.

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13 3. A multiplicity of centrifuge means as
14 defined in claim 1, arranged such that the separated
15 gases are further concentrated by introducing them into
16 successive of said gas centrifuge means.

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19 4. A multiplicity of centrifuge means as
20 defined in claim 2 configured such that the separated
21 streams of carbon dioxide and methane are further
22 concentrated by introducing them into successive of
23 said gas centrifuge means.

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1 5. A gas centrifuge comprising, in
2 combination:
3 a) a hollow shaft to pass and introduce a
4 gas mixture into a rotating cylinder,
5 b) said cylinder having axial vanes to
6 cause the gas mixture to rotate with the same angular
7 speed of the cylinder,
8 c) a radial passage connected to the
9 periphery of the cylinder to receive and pressurize a
10 produced and concentrated heavier gas stream,
11 d) a nozzle connected to the passage to
12 convert the pressure of the heavier gas stream to
13 velocity adding a torque to the cylinder, and
14 e) an opening in the hollow shaft to
15 receive and remove a produced and concentrated lighter
16 gas stream from the cylinder.

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19 6. A gas centrifuge comprising, in
20 combination:
21 a) a first nozzle accelerating a gas
22 mixture and introducing it into a rotating cylinder,
23 adding torque to the cylinder,
24 b) said cylinder having associated vanes to
25 receive torque from the flowing gas and causing the gas
26 to rotate with the same angular speed as the cylinder,

1 c) a radial passage connected to the
2 periphery of the cylinder operating to pressurize a
3 produced and concentrated heavier gas stream,
4 d) a second nozzle connected to the passage
5 and operating to convert the pressure of the heavier
6 gas stream to velocity, adding torque to the cylinder,
7 e) an open scoop oriented perpendicular to
8 the direction of rotation operating to remove a
9 produced and concentrated lighter gas from the
10 cylinder, and
11 f) a passage contoured and operating to
12 recover the velocity head of the concentrated lighter
13 gas as pressure.

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16 7. A gas centrifuge comprising, in
17 combination:

18 a) a first nozzle accelerating a gas
19 mixture and introducing it into a rotating cylinder,
20 adding torque to the cylinder,
21 b) said cylinder having associated vanes to
22 receive torque from the flowing gas and causing the gas
23 to rotate with the same angular speed as the cylinder,
24 c) a first radial passage connected to the
25 periphery of the cylinder operating to pressurize a
26 produced and concentrated heavier gas stream,

1 d) a second nozzle connected to the first
2 passage and operating to convert the pressure of the
3 heavier gas stream to velocity, adding torque to the
4 cylinder,

5 e) a second radial passage connected to the
6 periphery of the cylinder operating to pressurize a
7 produced and concentrated lighter gas stream,

8 f) a third nozzle connected to the second
9 passage and operating to convert the pressure of the
10 lighter gas stream to velocity adding torque to the
11 cylinder.

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14 8. The combination of claim 5 where the
15 heavier gas stream consists of carbon dioxide and the
16 lighter gas stream consists of methane.

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19 9. The combination of claim 6 where the
20 heavier gas stream consists of carbon dioxide and the
21 lighter stream consists of methane.

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1 10. The combination of claim 7 where the
2 heavier gas stream consists of carbon dioxide and the
3 lighter stream consists of methane.

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6 11. The combination of claim 5 wherein seals
7 are provided to isolate cylinder inlet and exit gas
8 streams from each other and from gas surrounding the
9 cylinder.

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12 12. The combination of claim 6 wherein seals
13 are provided to isolate cylinder inlet and exit gas
14 streams from each other and from the gas surrounding
15 the cylinder.

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18 13. The combination of claim 7 wherein seals
19 are provided to isolate cylinder inlet and exit gas
20 streams from each other and from the gas surrounding
21 the cylinder.

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24 14. The combination of claim 5 wherein
25 bearings are provided to support the shaft.

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1 15. The combination of claim 6 wherein
2 bearings are provided to support the shaft.

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5 16. The combination of claim 7 wherein
6 bearings are provided to support the shaft.

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9 17. The combination of claim 5 wherein a
10 prime mover is connected to the shaft to rotate the
11 cylinder.

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14 18. The combination of claim 6 wherein a
15 prime mover is connected to the shaft to rotate the
16 cylinder.

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19 19. The combination of claim 7 wherein a
20 prime mover is provided and is connected to the shaft
21 to rotate the cylinder.

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24 20. The combination of claim 6 including a
25 shaft supporting the cylinder for rotation, and a
26 housing enclosing and supporting the shaft.

1 21. The combination of claim 20 wherein said
2 first nozzle is carried by the housing, at one end of
3 the cylinder.

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6 22. The combination of claim 21 wherein said
7 second nozzle is located near the opposite end of the
8 cylinder, said vanes located between said first and
9 second nozzles.

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12 23. A cascade of centrifuges as defined in
13 claim 8.

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16 24. A cascade of centrifuges as defined in
17 claim 9, for successively increasing concentrations of
18 carbon dioxide and methane in said streams.

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21 25. A cascade of centrifuges as defined in
22 claim 10.

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1 26. The method that includes
2 a) providing a rotary centrifuge to receive
3 a mixture of gases having carbon dioxide and/or other
4 heavy gases and methane components,
5 b) operating the rotary centrifuge to
6 separate said components into separate streams,
7 c) using the separated stream of carbon
8 dioxide and methane to produce torque acting to aid
9 rotation of the centrifuge.

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12 27. The method of claim 26 including using
13 said mixture received by the centrifuge as a flowing
14 stream to produce torque acting to aid rotation of the
15 centrifuge.

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18 28. The method of claim 27 including
19 providing vanes in the centrifuge to receive and pass
20 the flowing stream, with turbine effect.

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1 29. A centrifugal gas processing system

2 comprising:

3 a) a centrifugal means to separate free
4 liquids from gas, light liquids from heavy liquids, and
5 solids from liquids,

6 b) a centrifugal means to extract liquids
7 from said a) gas by lowering the pressure and
8 temperature and separating the formed liquids from the
9 gas,

10 c) a centrifugal means to process said a)
11 gas thereby to separate heavy gases from light gases.

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14 30. The combination of the claim 29 system
15 together with a means to inject a treatment liquid into
16 said system for purposes of gas treatment.

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19 31. A centrifugal gas processing system

20 comprising:

21 a) a centrifugal means to separate free
22 liquids from gas, light liquids from heavy liquids, and
23 solids from liquids,

24 b) a centrifugal means to extract liquids
25 from said a) gas by lowering the pressure and

1 temperature and separating the formed liquids from the
2 gas.

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5 32. A centrifugal gas processing system,
6 comprising in combination:

7 b) a centrifugal means to extract liquids
8 from gas by lowering the pressure and temperature and
9 separating the formed liquids from the gas,

10 c) a centrifugal means to process said gas
11 thereby to separate heavy gases from light gases.

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14 33. A centrifugal gas processing system,
15 comprising:

16 a) a centrifugal means to separate free
17 liquids from gas, light liquids from heavy liquids, and
18 solids from liquids,

19 b) a centrifugal means to process said a)
20 gas thereby to separate heavy gases from light gases.

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23 34. The combination of claim 32 together
24 with means to inject a treatment liquid into said
25 system for purposes of gas treatment.

1 35. A gas processing system comprising
2 a) a centrifugal means to extract liquids
3 from gas by lowering the pressure and temperature and
4 separating the formed liquids from the gas,
5 b) means to inject a treatment liquid into
6 said system for purposes of gas treatment.

Sub B3 cont

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